

HEALTH CONSULTATION

Lydia Patterson School

EL PASO, EL PASO COUNTY, TEXAS

September 10, 2002

Prepared by:

The Texas Department of Health
Under a Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

BACKGROUND AND STATEMENT OF ISSUES

The Texas Department of Health (TDH) and the Agency for Toxic Substances and Disease Registry (ATSDR) were asked to determine the public health significance of the lead and arsenic found in one surface soil sample (0 to 1 inch in depth), composited from a five-point aliquot of approximately equal volume. The sample was collected on March 2, 2002, from one of two areas outside the Lydia Patterson School. This sample contained 15 milligrams of arsenic per kilogram of soil (15 mg/kg) and 340 mg/kg of lead. All other ground surface areas of the school are paved.

DISCUSSION

Public Health Implications

Lead

We evaluate the public health significance of lead in soil by estimating the potential impact that it may have on the blood lead levels of potentially exposed populations. For this consultation we considered potential exposure of adults, children, and the developing fetus of adult females that frequent the school grounds. In general, lead in soil has the greatest impact on preschool-age children as they are more likely to play in dirt and place their hands and other contaminated objects in their mouths. They also are better at absorbing lead through the gastrointestinal tract than adults and are more likely to exhibit the types of nutritional deficiencies that facilitate the absorption of lead. While lead in soil also can have an impact on adults and the developing fetus (through maternal exposure), the potential impact on these populations is low compared to the potential impact on young preschool-age children.

The Centers for Disease Control and Prevention (CDC) has determined that a blood lead level at or above 10 micrograms per deciliter ($\mu\text{g/dL}$) in children indicates excessive lead absorption and is grounds for intervention [1, 2]. While no clear relationship between soil lead levels and blood lead levels is applicable to all sites, some models have been developed to estimate the potential impact that lead in soil could have on different populations [3–5]. For children, the predicted 95th percentile blood lead level associated with a soil lead concentration of 500 mg/kg is approximately 10 $\mu\text{g/dL}$. This means that, except in the most extreme cases (i.e., frequent contact by children exhibiting pica behavior, or desire for unnatural foods such as dirt or ashes), children regularly exposed to soil lead levels of 500 mg/kg should have no more than a 5% probability of having blood lead levels greater than 10 $\mu\text{g/dL}$. Based on the goal of limiting the probability of exceeding a blood lead level of 10 $\mu\text{g/dL}$ to no more than 5%, depending on individual exposure situations, the concentrations of lead in soil where children might have regular contact should be less than 500 mg/kg. Exceeding this value should not be taken to imply that the contaminant will cause harm but does suggest that it warrants further consideration.

Critical blood lead levels for adults are less well established. The Occupational Safety and Health Administration (OSHA) recommends that workers whose blood lead levels exceed 40 $\mu\text{g/dL}$ be evaluated medically and workers whose blood lead levels exceed 60 $\mu\text{g/dL}$ be removed from the exposure. In Texas, workers with blood lead levels greater than 25 $\mu\text{g/dL}$ must be reported to TDH. For adults who work at or frequent the school areas, we based our assessment on the same goal of limiting the probability of exceeding a blood lead level of 10 $\mu\text{g/dL}$ to no more than 5%.

The concentration of lead in the single soil sample was less than the 500 mg/kg screening value for children. Although schools are areas where both children and adults could contact soil, based on the single sample, the concentrations of lead to which people might be exposed is less than 500 mg/kg and would not pose a risk either to children or adults [3! 5]. Any potential risks are further reduced by the fact that the exposure assumptions that we used to derive the screening values assume that people contact the soil every day and that the soil at the school is the only soil to which they are exposed. The area where the sample was taken is small and under the worst case scenarios would only account for a small fraction of a person's soil ingestion. Based on these data, we would not anticipate the lead in the soil to present a public health hazard to any of the potentially exposed populations.

Arsenic

To assess the potential health risks associated with the arsenic in the soil, we compared the soil concentrations to a health-based screening value specific to arsenic. This screening value represents a level in the soil that is considered safe for human contact. While exceeding this screening value does not imply that the contaminant will cause harm, it does suggest that potential exposure to the contaminant warrants further consideration.

The screening value that we used for arsenic in soil (20 mg/kg) is based on a child exposure scenario and the U.S. Environmental Protection Agency's (EPA) reference dose (RfD) for arsenic of 0.3 µg/kg/day [6]. RfDs are based on the assumption that an identifiable exposure threshold exists (both for the individual and for populations) below which no observable adverse effects occur. Thus, the RfD is an estimate of a daily exposure to arsenic that is unlikely to cause adverse non-cancer health effects even if exposure were to occur every day for a lifetime. For arsenic, the RfD was derived by dividing the identified no observable adverse effects level (NOAEL¹) of 0.8 µg/kg/day, obtained from human epidemiologic studies, by an uncertainty factor of three. The lowest observable adverse effects level (LOAEL²) associated with these epidemiologic studies was 14 µg/kg/day, where exposure to arsenic above this level resulted in hyperpigmentation of the skin, keratosis (patches of hardened skin), and possible vascular complications [6–8]. We used standard assumptions for body weight (15 kg per child) and soil ingestion (200 mg per day per child) to calculate the screening value. Screening values calculated using child exposure scenarios also are conservative (health protective) with respect to protecting adults.

The concentration of arsenic in the single soil sample from the school was less than the 20 mg/kg screening value. Any potential risks are further reduced by the fact that the exposure assumptions that we used to derive the screening value assume that people contact the soil every day and that the soil at the school is the only soil to which they are exposed. The area where the sample was taken is small and under the worst case scenario would only account for a small fraction of a person's soil ingestion. Based on these assumptions it is not likely that children or adults who regularly eat soil from the school would experience adverse non-cancer health effects.

¹The highest dose at which adverse effects were not observed.

²The lowest dose at which adverse effects were observed.

EPA classifies arsenic as a known human carcinogen based on sufficient evidence from human data. An increase in lung cancer mortality was observed in multiple human populations exposed primarily through inhalation. Increased mortality from multiple internal organ cancers (liver, kidney, lung, and bladder) and an increased incidence of skin cancer (non-malignant) were observed in populations consuming water high in inorganic arsenic [6]. We used EPA's cancer slope factor (CSF) for arsenic to estimate the potential increased lifetime cancer risks associated with exposure to arsenic in soil from these schools. For people exposed to the soil from the schools every day for 9 years, we estimate there to be no apparent increase in the lifetime risk for cancer. Based on these data, we would not anticipate the arsenic in the soil from the school to present a public health hazard to any of the potentially exposed populations.

Uncertainties

General Uncertainties

The conclusions in this consultation are based on data developed by EPA contractors. Although a description of the quality assurance and quality control (QA/QC) measures used to evaluate these data were not available for review, EPA Region 6 personnel indicated that the data were QA/QC'd to their satisfaction. We assumed the data to be accurate unless specifically qualified.

The most likely routes of exposure for the contaminants found in the soil are ingestion (eating the soil) and inhalation (breathing in the soil as windblown dust). Based on the information available for this consultation, we would not anticipate the inhalation of windblown dust to be a major contributor to exposure even though windblown dust may be common in El Paso. Overall, the concentrations of the contaminants in the soil are low and would not likely result in any significant loading of the air with contaminants.

For exposure to the contaminants to occur through ingestion, the soil must be physically available. The screening values that we used in this consultation assume that the soil is available and that physical barriers such as grass are not present. The presence of the grass would further reduce the likelihood for exposure. Individual behavior patterns also are important in assessing risk. The amount of soil that a person eats, how often they eat the soil, and the average concentration of the contaminant in the soil that they eat all are important factors in determining potential public health implications. For this consultation we assumed that people would eat soil from the school every day and that their total daily consumption of soil and dust would come from the school. In most instances these types of assumptions overestimate the potential exposures.

Specific Uncertainties

Considerable controversy exists with respect to assessing potential risks associated with exposure to arsenic. Both the RfD and the CSF are based on human ecological studies that have recognized uncertainties with respect to the assignment of exposure. Such studies find it difficult to avoid errors in assigning people to specific exposure groups. The studies upon which the RfD and the CSF are based also involved exposure to arsenic in drinking water. The ability of the body to absorb arsenic in water is likely higher than the ability of the body to absorb arsenic in soil. In our analysis we assumed that the arsenic in the soil was 100% absorbed. Assuming that the applied dose (the amount available for absorption) is the same as the internal dose (the amount that has been absorbed), is conservative and to some unknown extent overestimates the risk. We also did not consider the kinetics of arsenic in the body in our risk estimates. The RfD

and the CSF are based on daily exposures over a lifetime. Since the half-life (the time it takes half of the absorbed arsenic to be excreted) is short (40 to 60 hours), the risk estimates for exposures that occur less frequently than every day also may result in an overestimate of the risks.

With specific respect to the cancer risk estimates, the mechanisms through which arsenic causes cancer are unknown; however, arsenic is not believed to act directly with DNA. Because the studies used to derive the CSF are based on exposure doses much higher than those likely to be encountered at this site, it is questionable whether it is appropriate to assume linearity for the dose-response assessment for arsenic at low doses. The actual dose-response curve at low doses may be sublinear, which would mean that the risk estimates in this consultation overestimate the actual risks.

ATSDR's Child Health Initiative

We recognize that the unique vulnerabilities of children demand special attention. Windows of vulnerability (critical periods) exist during development, particularly during early gestation, but also throughout pregnancy, infancy, childhood and adolescence—periods when toxicants may permanently impair or alter structure and function [6]. Unique childhood vulnerabilities may be present because, at birth, many organs and body systems (including the lungs and the immune, endocrine, reproductive, and nervous systems) have not achieved structural or functional maturity. These organ systems continue to develop throughout childhood and adolescence. Children may exhibit differences in absorption, metabolism, storage, and excretion of toxicants, resulting in higher biologically-effective doses to target tissues. Depending on the affected media, they also may be more exposed than adults because of behavior patterns specific to children. In an effort to account for children's unique vulnerabilities, and in accordance with ATSDR's Child Health Initiative [7] and EPA's National Agenda to Protect Children's Health from Environmental Threats [8], we used the potential exposure of children as a guide in assessing the potential public health implications of the contaminants.

CONCLUSIONS

Based on limited sampling, the concentrations of lead and arsenic in soil from the school did not exceed their respective soil-based screening values. Thus, it is unlikely that people frequenting the school grounds would experience adverse health effects associated with the contaminants found in the soil. Based on the available information we have concluded that the concentrations of lead and arsenic found in soil from the school **do not pose a public health hazard** to any of the potentially exposed populations.

PUBLIC HEALTH ACTION PLAN

Actions Recommended

None at this time.

REFERENCES

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5. Society for Environmental Geochemistry and Health. 1993. Lead in soil, recommended guidelines. Science Reviews.
6. US Environmental Protection Agency. 2000. Strategy for research on environmental risks to children. Washington, DC: US Environmental Protection Agency, Office of Research and Development. EPA/600/R-00/068, Section 1.2.
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8. US Environmental Protection Agency. The children's environmental health yearbook; 1998.

PREPARERS OF THE REPORT

John F. Villanacci, Ph.D.
Co-Director
Environmental Epidemiology and Toxicology Division

ATSDR REGIONAL REPRESENTATIVE

Jennifer Lyke
Regional Representative
ATSDR - Region 6

George Pettigrew, PE
Senior Regional representative
ATSDR - Region 6

ATSDR TECHNICAL PROJECT OFFICER

Robert Knowles, M.S.
Environmental Health Scientist
Division of Health Assessment and Consultation
Superfund Site Assessment Branch
State Programs Section

CERTIFICATION

This health consultation was prepared by the Texas Department of Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the health consultation was initiated.

Technical Project Officer, SPS, SSAB, DHAC, ATSDR

The Division of Health Assessment and Consultation, ATSDR, has reviewed this health consultation and concurs with its findings.

Chief, Superfund Site Assessment Branch, DHAC, ATSDR